REMARKS

The Office action of April 17, 2003 has been received and its contents carefully considered.

The Examiner has not acknowledged applicants' claims for domestic priority to two (2) provisional applications. Applicants request the Examiner to make such acknowledgements.

The Examiner has attached to the Office Action a copy of the Form PTO-1449 filed with the Information Disclosure Statement of August 16, 2001 and a copy of the Form PTO-1449 filed with the Information Disclosure Statement of September 20, 2001.

The Examiner has initialed and dated the Form PTO-1449 filed with the Information Disclosure Statement of August 16, 2001, except that he has crossed off five of the references cited on this Form. The Examiner has not provided any explanation why he has crossed off these references from the Form. Applicants submit that these references should be maintained on the Form, and request the Examiner to place his initials next to each reference and date the Form to indicate that he has considered and made of record all of the references listed on the Form. The five references that the Examiner crossed off are JP 44-23138, JP-5254957, JP 2-58369, JP 2-23505 and JP 7-115970. Applicants note that as stated in the Information Disclosure Statement of August 16, 2001, concise explanations of relevance were provided for the last four of these references by their disclosure and discussion at page 2 of the present specification. A concise explanation of relevance of the last reference, JP 44-23138, was provided in the Information Disclosure Statement filed on September 20, 2001.

With respect to the Form PTO-1449 filed with the Information Disclosure Statement of September 20, 2001, the Examiner has initialed and dated this Form to indicate that he has

considered and made of record U.S. Patent 3,484,183 to Dickson et al, but he has crossed off JP 44-23138 from this Form. The Examiner has written on this Form that this JP reference was considered in the previous Information Disclosure Statement. However, in the previous Information Disclosure Statement, the Examiner crossed off JP 44-23138. Accordingly, applicants request that the Examiner make of record JP 44-23138.

Claims 4 and 5 have been rejected under the second paragraph of 35 U.S.C. § 112 as indefinite.

The Examiner states that these claims contain the recitation "the orientation of the carbon fiber woven fabric as defined in the present specification". The Examiner states that this recitation is vague and indefinite because it refers to the specification without clearly defining what this term means in the claim.

In response, applicants have amended claims 4 and 5 to delete the phrase "as defined in the present specification". The definition of the "orientation" of the carbon fiber woven fabric can be found at page 9 of the specification. Applicants submit that it is not necessary to have this detailed description in the claim, since applicants are entitled to rely on the definition found in the specification. Thus, since the specification defines what is meant by the term "orientation", applicants can rely on the definition that is found in the specification, without describing in detail in the claim how the orientation is measured.

Applicants note that they have amended claim 5 to add the phrase "having an orientation" to improve the readability of the claim, and have amended claims 4 and 5 so that there is no question of antecedent basis for the term "orientation".

In view of the above, applicants submit that claims 4 and 5 comply with the requirements of the second paragraph of 35 U.S.C. § 112 and, accordingly, request withdrawal of this rejection.

Claims 1-8 have been rejected under 35 U.S.C. § 102(b) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over Dickson et al.

Applicants submit that Dickson et al do not disclose or render obvious the subject matter of the present claims.

Applicants have rewritten claim 3 to place it in independent form, and have cancelled claims 1 and 2. Applicants have amended the dependency of claims 4 to 9 to depend from claim 3, and have added a new dependent claim 13, which depends from claim 3 and which recites subject matter from claim 2.

As set forth in claim 3, the present invention is directed to a carbon fiber woven fabric that is obtained by firing a cellulose-based woven fabric, and which has a thickness in the range of 0.05-0.4 mm, a volume resistivity of less than 0.2Ω•cm in the layer direction, and a gas permeability of not less than 1500/cc/cm^2/hr/mmAq, and wherein the electrical resistance in the direction of thickness of the woven fabric is no greater than 50 mΩ•cm^2 as measured between two copper plates with a load of 4 kgf/cm^2.

The Examiner states that Example 2 of Dickson et al discloses a carbon fiber cloth having a thickness of about 0.025 inches, which equals 0.635 mm. The Examiner acknowledges that this value falls outside of the range of the present claims where the thickness is recited to be 0.05 to 0.4 mm. The Examiner, however, states that Dickson et al disclose, at column 4, line 48, that

the rayon yarn used to make the fabric may have a diameter ranging from about 5 to about 30 microns. The Examiner states that employing a rayon yarn with a diameter of 5 microns would inherently create the thickness dimension recited in claim 1.

Applicants submit, however, that the Examiner is not correct that the use of a rayon yarn having a diameter ranging from 5 to about 30 microns would inherently create the thickness dimension recited in claim 1, or in claim 3 which recites the same thickness dimension that was recited in claim 1.

Applicants do not know how the Examiner arrives at his conclusion that the use of a rayon yarn having this diameter range would inherently create the thickness recited in claim 1.

Applicants point out that the fiber diameter does not have a direct relationship with the thickness of the fabric, since a fabric is formed of yarns which in turn are made of a number of fibers, and the yarn thickness or diameter is determined by not only the diameter of fiber, but also the number of fibers used to form the yarn. Further, the thickness of a fabric is reduced after firing, and the amount of the thickness reduction varies depending on a fabric.

Even it the fiber diameter of about 5 to 30 microns (0.005 to 0.30 mm) mentioned in Dickson et al overlaps the fiber diameter of the present invention, the post-firing thickness of a fabric is not directly determined by the fiber diameter.

Applicants point out further that the fiber diameter is not limitative, and is not stated in claim 3 or in any other claim.

The present invention resides in the thickness of a carbon fiber woven fabric in a range of 0.05 to 0.4 mm, not the fiber diameter.

The carbon fiber woven fabric of the present invention has a sufficient mechanical strength and an excellent conductivity in the direction of the thickness (layer transverse direction) of the woven fabric, which is useful, for example and particularly, as an electrode for a fuel cell. A carbon fiber woven fabric having an electrical resistance in the direction of the thickness of the carbon fiber woven fabric as in the present invention has not been known in the prior art.

Thus, Dickson et al do not disclose or suggest teach the present invention, either expressly or inherently.

The Examiner argues that, alternatively, a decrease in the thickness of the fabric would result in an adjusting of a result effective variable, with the result being a decreased resistivity. The Examiner argues that it would have been obvious to make the thickness of the carbon fabric smaller than 25 mils in order to decrease its resitivity, since legal decisions indicate that discovering an optimum value of a result effective variable involves only routine skill in the art.

Applicants point out, however, that the Examiner is not correct that a decrease in the thickness of the fabric would result in a decreased resistivity.

Reduction of the thickness of a fabric does not result in a decrease in the electrical resistance (in the direction of the fabric layer) as long as the material is the same. The electrical resistance in the direction of the fabric layer is the inherent electrical resistance of the material.

The present invention has attained a reduced electrical resistance in the direction of the thickness of the carbon fiber woven fabric of 50 $m\Omega \cdot cm^2$ or less under a load of $4kgf/cm^2$. This advantageous characteristic of the present invention is not attained or suggested in Dickson et al.

The Examiner states that with respect to the other property recitations of the claims, that although Dickson et al do not specifically disclose the recitations for gas permeability, compressive strength, electrical resistance measured between two copper plates, and orientation, he takes the position that it is reasonable to presume that these recitations are inherent in the Dickson et al invention.

The Examiner argues that his presumption of inherency is reasonable because similar materials are employed, that is, cellulose-based woven fabrics, in a similar production process, that is, firing in a non-oxidizing atmosphere to create a carbon fabric to produce a conductive carbon fabric. The Examiner states that the burden is upon applicants to show that the Dickson et al process would not inherently result in the recitations of the present claims.

Applicants submit that the Examiner is not correct that the process described in Dickson et al would inherently result in the recitations of the present claims. Inherency exists only when the process disclosed in the prior art necessarily and always produces the same result. In the present case, the Examiner is merely guessing that the same result may be obtained because "similar" materials and processes allegedly were employed. This is insufficient to support an allegation of inherency.

Further, Dickson et al do not note the relationship between the orientation of a cellulose fabric and the layer transverse direction electrical resistance. In preferred embodiments of the present invention, a high orientation is used to obtain a low layer transverse direction electrical resistance of the carbon fiber fabric.

The present inventor found that use of a certain cellulose fabric in a certain manner and fired to obtain a carbon fiber fabric can produce a carbon fiber fabric having desirable properties, which was not known.

Further, the production process of a carbon fiber fabric is not the same between Dickson et al and the process that was employed to obtain the carbon fiber woven fabric of the present invention. In Dickson et al, a black insulating fiber material is first obtained by a thermochemical conversion of regenerated-cellulose fiber starting material by impregnating clean starting material with a metal phosphate salt, and heating the salt-impregnated fiber material for a short time of 5 to 30 minutes in air to produce a flexible black insulative fiber material, and then carbonizing this black material by rapidly heating for 5 to 30 minutes in a non-oxidizing atmosphere to form an electrical conductive fiber material. In a typical process that was employed to obtain the carbon fiber woven fabric of the present invention, a cellulose material was heated in non-oxidizing atmosphere at 900°C (Examples 1-4) for 1 week to obtain a carbonized material, which is then further fired at 1800°C, if necessary, to obtain a carbon fiber fabric. Thus, Dickson et al used a thermochemical conversion in an oxygen atmosphere and a subsequent rapid carbonization, whereas a typical process employed to produce the carbon fiber woven fabric of the present invention employed an extended firing in a non-oxidizing atmosphere, to form a carbon fiber fabric. Thus, the process is different between Dickson et al and a typical process that was employed to produce the carbon fiber woven fabric of the present invention.

Thus, the present invention does not reside in recitations of properties which can be obtained only by adjustment of the Dickson et al process.

The Examiner states that, alternatively, these claimed properties would have been obvious to arrive at by adjusting the result effective variables to improve the conductivity of the fabric.

Applicants' submit that it would not have been obvious to adjust the various result effective variables of Dickson et al to arrive at the properties set forth in the present claims. Dickson et al do not provide any guidance or motivation to adjust variables to arrive at the properties of gas permeability and orientation recited in the present claims. Thus, Dickson et al do not even mention gas permeability and orientation as properties that are of any importance. Therefore, one of ordinary skill would not be motivated to find the optimum values for these properties.

The Examiner states that with respect to claim 8, Dickson et al disclose, at column 14, lines 36-39, that the properties can be modified by inclusion of fluoro-carbon fibers. Applicants assume the Examiner meant to refer to claim 7 of the present specification, which recites that the fabric has a water repellent property.

Dickson et al describe inclusion of fibers of other types such as fluoro-carbon fibers in varnish or resin impregnant to modify ablative and other properties.

However, even if a fabric containing fluoro-carbon fibers is fired, a carbon fiber fabric having a water repellant property of claim 7 of the present application cannot be obtained. In order to obtain a carbon fiber fabric having a water repellent property of claim 8, it is necessary

to coat a water repellant resin onto a carbon fiber fabric. Dickson et al do not teach such a coating.

Further, the amount of the water repellant resin preferably should be not more than 60% by mass, so as not to deteriorate the electrical resistance and gas permeability. Dickson et al do not teach coating of a water repellant resin, or anything about electrical resistance and gas permeability.

Accordingly, applicants submit that claim 7 provides a further basis for patentability over Dickson et al.

Further, Dickson et al do not disclose or suggest the orientation recited in claims 4 or 5. Accordingly, applicants submit that these claims provide an additional basis for patentability over Dickson et al.

In view of the above, applicants submit that Dickson et al do not disclose or render obvious the subject matter of the present claims and, accordingly, request withdrawal of this rejection.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

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APPENDIX
VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

Claims 1 and 2 are canceled.

The claims are amended as follows:

3. (Amended) ~~The~~ A carbon fiber woven fabric ~~as claimed in claim 1~~ obtained by firing a cellulose-based woven fabric, and having a thickness in the range of 0.05-0.4 mm, a volume resistivity of less than 0.2 Ω•cm in the layer direction, and a gas permeability of not less than 1500 cc/cm^2/hr/mmAq, and, wherein the electrical resistance in the direction of thickness of the woven fabric is no greater than 50 mΩ•cm^2 as measured between two copper plates with a load of 4 kgf /cm^2.

4. (Amended) The carbon fiber woven fabric as claimed in claim ~~1~~, wherein the carbon fiber woven fabric has an orientation ~~of the carbon fiber woven fabric as defined in the present specification~~ which includes an orientation component having an orientation of 4/9 or greater.

5. (Amended) The carbon fiber woven fabric as claimed in claim ~~1~~, wherein the carbon fiber woven fabric has an orientation ~~of the carbon fiber woven fabric as defined in the present specification~~ which is an average of 1/3 or greater.

6. (Amended) The carbon fiber woven fabric as claimed in claim ~~1~~ 3 which is a plain weave.

7. (Amended) The carbon fiber woven fabric as claimed in claim ~~1~~ 3 which has a water repellent property.

8. (Amended) ~~The~~ A gas diffusion porous carbon sheet for a solid polymer fuel cell which comprises a carbon fiber woven fabric as claimed in claim ~~1~~3.

Claim 13 is added as a new claim.